UCRL-JC-123610 Abs

IMPACT OF HIGH SPEED CIVIL TRANSPORTS ON STRATOSPHERIC OZONE: A 3-D MODEL INVESTIGATION

Douglas E. Kinnison, Peter S. Connell, Douglas A. Rotman, Keith E. Grant, Allen S. Grossman, John Tannahill, Dan Bergmann, Joyce E. Penner
Atmospheric Science Research Division, L-240
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, CA 94551, USA

Steven L. Baughcum
Boeing Company
P.O Box 3707, MS 6H-FC
Seattle Washington, 98124, USA

Donald J. Wuebbles
Department of Atmospheric Sciences
University of Illinois at Urbana-Champaign
106 Atmospheric Sciences Building
105 South Gregory Avenue
Urbana, IL 61801-3070, USA

The aviation community is interested in developing a fleet of High Speed Civil Transports or HSCTs (e.g., Stolarski et al., 1995). These prototype aircraft are designed to cruise at Mach 1.6 - 2.4 with a range of 5000 to 6500 nautical miles. The primary market for these new supersonic passenger aircraft will be in the Atlantic and Pacific flight corridors. This HSCT fleet will cruise in the low stratosphere, within an ozone rich region. Effluents from this proposed fleet (e.g., NOx, H2O, CO, and Hydrocarbons) will predominately be contained within the Northern Hemisphere, mid-latitude / lower-stratosphere. Numerous past studies have used 2-D chemical-transport models to assess HSCT ozone impacts. These models have reasonably complete representation of stratospheric photochemical processes, but are limited in their representations of stratospheric dynamics and stratospheric / tropospheric exchange. In this study the potential impact on stratospheric ozone from a proposed fleet of HSCTs will be examined in 3-D using the LLNL 3-D chemical-transport model (IMPACT) of the global atmosphere. Transport fields for IMPACT

are obtained using data assimilated meteorological fields (winds, temperature, etc.) from the Data Assimilation Program at NASA-Goddard. A realistic passenger load scenario with projected future technology engines is used to derive the proposed fleet effluents emission rate. Detailed comparison of 3-D derived stratospheric ozone change will be compared to previous 2-D calculations with special attention focussed on the impact of the zonal-symmetry assumptions used in 2-D models.

Stolarski et al., Scientific Assessment of the Atmospheric Effects of Stratospheric Aircraft, NASA Reference Publication 1281, 1995.

Work at Lawrence Livermore National Laboratory was performed under the auspices of the U.S. Department of Energy under Contract W-7405-ENG-48.